Space Weather Technical Forecast

Issued on Monday, 14 February 2022 at 00:34 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Minor R1 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low with several C class flares observed. The largest of which was a C7 at 13/2142 UTC. The source of this flare was AR2941. AR2941 remains long and complex with beta-gamma configuration and possible hints towards becoming delta configuration once again. It is currently a mature Fai/Beta-Gamma and an M-Class flare may not be unreasonable from such a spot. There are two other regions on the visible disk, AR2946 in the southeast, and a NEW spot in the northwest. Both are relatively weak and stable.

The past 48 hours have seen numerous apparently minor Coronal Mass Ejections (CMEs) on coronagraph imagery. None of these appear to have an Earth-directed component, emanating mostly in the rear-facing western quadrant. In particular, there is an absence of any westward-directed ejecta on STEREO A COR2 imagery (i.e. potentially in the Earth sector). At present no confirmed Earth-directed Coronal Mass Ejections (CMEs) were in evidence, but confidence is lower than average.

Solar Wind / Geomagnetic Activity: Solar winds, as measured DSCOVR at L1, have fallen from elevated to slightly elevated, ending the period around 490 km/s. The source of this fast wind is related to CH53/-, with the phi angle accordingly negative (towards the sun). Density was mostly near, or slightly above average. The IMF was weak and peaked around 7nT, with a range in north-south component (Bz) from +6nT to -6nT. The net result of the above solar wind characteristics was Quiet to Unsettled geomagnetic activity (Kp 2-3), with one active interval at the very start of the period (Kp 4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at Background levels. The high energy electron flux (greater than 2MeV) started at Background levels and rose to High levels between 13/1300-2400 UTC with a peak of 5219 pfu at 13/1855 UTC. The corresponding 24-hour integrated electron fluence values also started at normal Background levels and rose above the 1e8 Active level at 13/2100 UTC. 1.22e8 integrated pfu was observed at 14/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mostly Low through the next four days, but with a Chance (30%) of M-class flares, mainly from AR2941 during days 1 and 2 (14th and 15th). Further sunspots are also expected to rotate around the eastern limb, therefore confidence is lower than usual.

Solar Wind / Geomagnetic Activity: No CMEs feature in this forecast period. The current high speed stream is due to CH53/-, and elevated or slightly-elevated solar winds are likely for much of the period, perhaps with a declining trend, this will result in generally Quiet to Unsettled geomagnetic activity, with a slight chance of Active intervals on day 1 (14th).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at Background levels, but with a daily Very Slight Chance of S1, mainly on days 1 and 2 (14th and 15th). The high energy electron flux is expected to continue fluctuating between Background and

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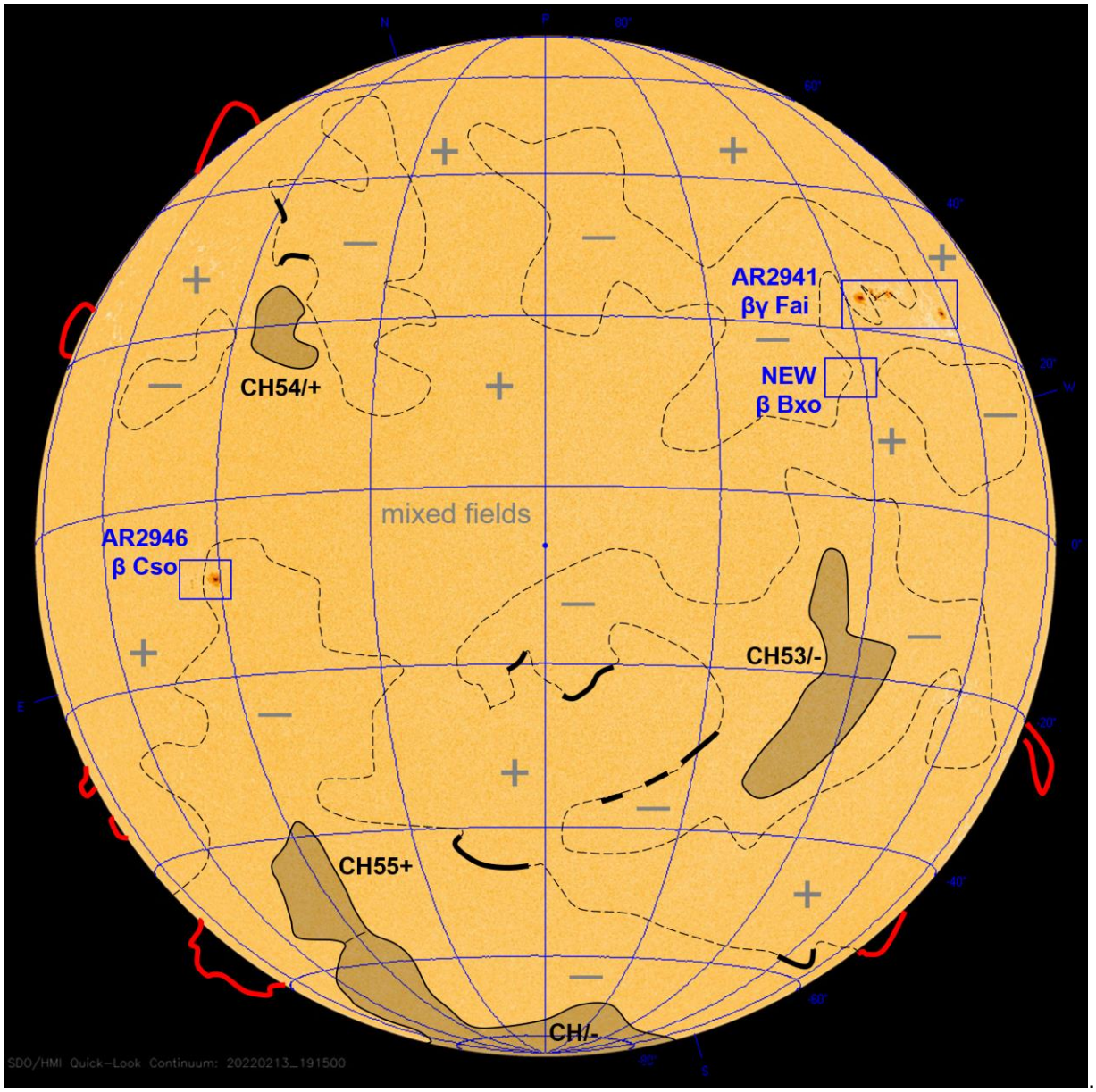
across the 1000 pfu High threshold each day during the diurnal maxima. Active (1e8 integrated pfu) electron fluence levels are expected each day due to the waning effects of CH53.

Figure 1. Solar Analysis Valid 13/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in this forecast at present, however confidence in this is somewhat lower than usual given numerous (particularly westward) CMEs. Earth is under the waning influence of a high speed stream (HSS) from CH53/-, closely matching persistence. Geomagnetic activity has likely peaked from this feature. Only slight fluctuations between Slightly Elevated and Elevated are expected from this feature, with Quiet to Unsettled activity most likely throughout, and a slight chance of Active intervals on day 1 (14th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	2	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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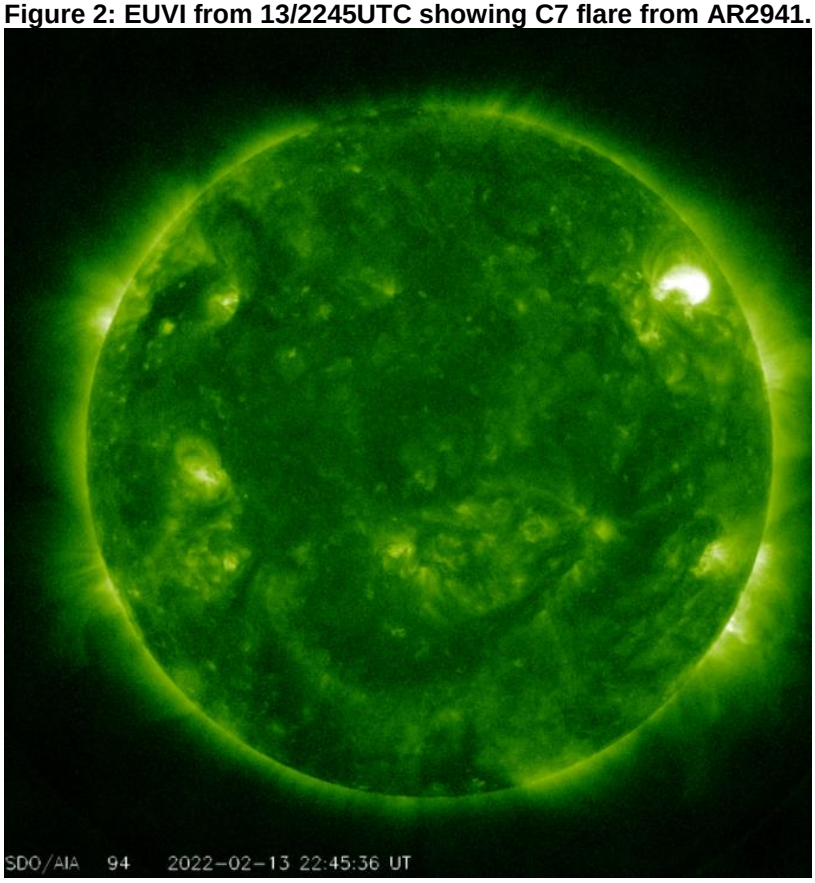
Radio Blackouts - X-Ray Flares:

The balance of sunspot groups should enter a state of flux over the forecast period. Returning regions Ex-2935 and Ex-2934 should begin to rotate onto the visible disc, with both appearing on far-side soundings and EUV imagery. This is in contrast to the depopulation expected to occur of the current western limb. This is all happening in the context of a changing disc, with flaring being observed from sources beyond the west limb as well as AR2941.

The X-ray forecast on balance starts with a daily Chance of M-class flares, reducing to a Slight Chance by days 3 and 4 (16 and 17 Feb), however this may be revised further downwards should the eastern horizon spots fall short of expectations as the western limb quietens down.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	10	5
Very Active	R3 to R5 X Class	No	2	2	2	1

Figure 2: EUVI from 13/2245UTC showing C7 flare from AR2941.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not expected in the period. However, there is a very slight chance for proton fluxes to rise given any significant flaring from regions close to the western limb, mainly on days 1 and 2 (14th and 15th).

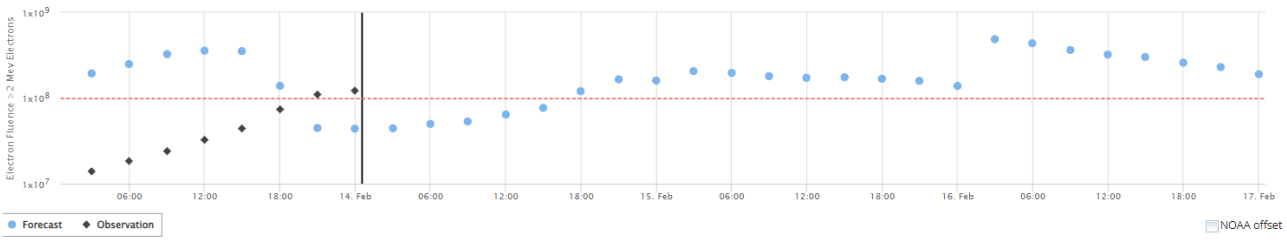
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	2	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Earth remains under the influence of CH53/-, but the fast wind effects of this coronal hole seem to be gradually waning, allowing for the flux and fluence levels to respond accordingly. This is similar to the last rotation, where the Active 24-hour integrated fluence threshold was marginally exceeded each day. This gives us greater than usual confidence that Active fluence levels are expected in the four-day period, with REFM likely providing a good guide to fluence trends.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	70	70	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: REFM showing electron Fluence forecast trends over the next 3 days.



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